Research proposal:

A preliminary investigation into the internalisation of environmental costs of electricity supply in South Africa

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Clive van Horen/Anton Eberhard
Energy for Development Research Centre
University of Cape Town
Rondebosch 7700
South Africa

Phone: (021) 650 3230
Fax: (021) 650 2830
E-mail: clive@energetic.uct.ac.za

Executive summary

An important comparative advantage currently enjoyed by South African producers is access to cheap and abundant energy supplies, and this is expected to form the basis of the country's future growth paths. It is not clear, however, how significant the environmental costs which are associated with energy supply might be, nor what impact such costs would have on price levels if they were to be internalised. This research proposal aims to address these questions by investigating the environmental costs of electricity supply, and the impact on prices if such costs were to be accounted for. The proposed project will be based at the Energy for Development Research Centre and in its initial phase will cost approximately R30 000. The outputs will assist in developing energy, environment and industrial policy and will form part of phase two of the Industrial Strategy Project. It is expected that this project may lead to a larger, more comprehensive project to investigate these issues in greater depth.

1 Introduction and background

This document contains a proposal for a research project to be carried out at the Energy for Development Research Centre as part of the Industrial Strategy Project. The proposed research will investigate the environmental costs associated with electricity supply, and the impact of such costs on electricity prices.

The project under discussion forms part of a larger programme of work being conducted in the second phase of the Industrial Strategy Project (ISP) on the broad theme of 'Labour, industry and environment'. The first phase of the ISP comprised a large research programme which investigated a number of industrial sub-sectors in the South African economy, and identified policy options which may shape the restructuring of the sector and improve its growth prospects in post-apartheid South Africa. Although many of the sectors which were studied have significant environmental impacts, the analysis did not focus strongly on economy-environment linkages. At the same time, several studies touched directly on the role of energy as an input into their processes, but the energy sector was not specifically addressed in the ISP. Consequently, a need has been identified for more detailed research into environmental issues affecting industrial activity, including the energy sector. The present proposal therefore addresses the issue of electricity, industry and environment.

2 Motivation for the research

South Africa has among the most energy-intensive economies in the world, mainly because of the dominance of coal and other minerals. In addition to the mining of coal for export, coal also forms the basis for over 90% of all electricity generated in the country. Furthermore, large quantities of coal are used by the synthetic fuel industry to produce petroleum and petrochemical products. This heavy dependence on coal is made possible by the availability of large, relatively accessible coal reserves, which are among the largest in the world.

Future development paths must clearly be influenced by what is a major comparative advantage: abundant supplies of high-quality, low-cost energy. Indeed, many analyses have suggested that this cheap energy should facilitate

the expansion of energy-intensive industries such as minerals beneficiation, and that this sector may become an engine of growth in the economy during the important years after the election of the country's first democratic government. Eskom, which has significant over-capacity on its electricity generation system, has even gone so far as to suggest that South Africa might become the 'electricity valley' of the world, offering cheap electricity and a range of other incentives to major industries considering new investments.

While the country's cheap energy resources do represent an important comparative advantage, especially in the short-term, there is some uncertainty over the extent to which this represents a *real* comparative advantage, or whether energy prices may be artificially low because they have not adequately accounted for environmental externalities. It may be that these environmental costs which are currently borne by society at large, and which result from the generation and use of electricity, would have a significant impact on price levels if they were to be internalised.

3 Objectives of the research

The overall objective of the research project will be to analyse the environmental costs associated with electricity supply in South Africa and to assess the impact on prices if such costs were to be accounted for. This is a complex and important area for policy research, and while the proposed project will not produce a definitive study of all the issues in involved, it will aim to produce substantive conclusions which can inform future industrial and energy policies. In pursuance of the primary objective, the proposed project will have two subsidiary objectives:

1. Firstly, it will undertake an approximate *quantification of external environmental costs* incurred in the production and use of electricity.
2. Secondly, the project will attempt to quantify the *impact on electricity prices* of scenarios in which environmental costs are internalised or reflected in the prices of electricity charged to consumers.

Many other important questions arise in relation to this subject, such as the extent to which gains may be made, possibly to offset any price increases which may arise due to accounting for environmental costs, in the broad area of *energy efficiency and demand-side management* in the industrial sector. Further, it might also be useful to investigate the relationship between *energy prices and economic development paths*, and the extent to which energy prices may or may not represent an important arena for active intervention in order to direct the economy along desired paths. While these are interesting and important questions for policy in South Africa, they will not be explicitly addressed in the current project; future work may include these components.

The focus of the project will be on electricity prices, although consideration will also be given to coal prices, because of the obvious links between the two. It is not proposed, however, that the project would address all aspects of energy pricing (such as petroleum products, domestic energy tariffs, and so on). The main link which will be explored is that between electricity prices and industrial activity, because of the centrality of this sector to the economy and environment.

4 Components of the research project

The proposed research will have two main components, which correspond to the objectives listed above.

4.1 Environmental costs and electricity supply

This component of the project will attempt to quantify the environmental costs associated with electricity supply, in order of magnitude terms. In practice, this can be approached from a number of directions, using a variety of conceptual and methodological approaches:

- Firstly, *environmental damage costs* can be estimated based on existing scientific information about environmental impacts linked to the electricity sector. This approach would rely heavily on evidence from the natural and geographical sciences about the impacts of environmental problems on agricultural productivity and so on.
- Secondly, appropriate *contingent valuation techniques* can be used to make estimates of the economic costs or values attached to environmental impacts. This method utilises well-developed approaches from the environmental economics discipline and would draw especially on the experience of using such approaches in other countries.
- Thirdly, *damage avoidance costs* can be estimated based on assessments of the approximate investment and operating costs of environmental controls and technologies which may feasibly be applied to South Africa. This will be based on both local investigations and international experience with installing environmental controls in the power sector.

This component of the project will, as a first step, review the various conceptual approaches which may be used in the valuation of environmental costs. This review will cover not only the theory underpinning the methods, but also international experience and trends in their application. Based on this review, it will then select one or more appropriate approaches as the basis for making estimates of the environmental costs incurred in South Africa's power sector.

4.2 Impacts on electricity prices of internalising costs

The second aspect of the project will calculate the incremental impact on industrial electricity prices of incorporating environmental costs, based on the quantifications produced in the first project component. This will be done for each set of cost estimates produced in the previous component, and will utilise scenarios to account for the many possible ways in which environmental costs could be introduced into the power sector.

The reasonableness of the results obtained will be checked by comparing them to the results of similar studies performed in comparable situations internationally.

5 Organisation of the project

5.1 Institutional arrangements

The project will be undertaken by the Energy for Development Research Centre (EDRC), and close links will be maintained with the wider range of projects being undertaken in this phase of work on the Industrial Strategy Project (ISP). EDRC staff engaged on the project will participate in the ISP's programme of

activities, including workshops and seminars. Although the project forms part of the ISP, it also is an area of work currently being expanded within EDRC and it is hoped that a longer-term, more systematic programme of work on this subject can be established (refer section 7).

5.2 Staffing and human resources

The project will be undertaken at EDRC by one person (Clive van Horen) during the period January to August 1995. Actual resource allocations represent approximately three to four months of one researcher's time.

Although EDRC's human resource policy is premised on a belief in the need to correct historical racial and gender imbalances in the profile of research and analytical staff, as well as the need to build human capacity for energy policy analysis, the scale of this project does not allow for the appointment of any new staff to give effect to the Centre's affirmative action policy. It is hoped that this area may receive more attention in an expanded or follow-up project. Brief curriculum vitae of EDRC persons to be involved with the project are included in the final section of this document.

6 Budget

The provisional budget for the project as described in the body of this proposal is R30 000. This represents the staff costs of one researcher for three to four months, with only a nominal contribution to EDRC's overheads and support costs. As far as possible, use will be made of the existing secretarial and support systems of the Industrial Strategy Project in order to minimise costs.

7 An expanded programme of work

It is clear from what has been indicated above that this project is of a modest scale and that it represents a preliminary investigation of a subject which is of growing political and economic interest. Limits on the resources available for the project at this stage have imposed restrictions on the scale and scope of the investigation.

Consequently, it is envisaged that the programme of work in this area may be *expanded*, either in the current project or in the future, to allow for more in-depth analysis and to address a number of related issues. Five of these issues are outlined briefly below, in a very approximate ordering of their priority and of the closeness of their links with the core of this project:

- The current project budget does not include any allowance for the costs of organising *workshops* nor for the costs of collaboration with *international experts* who have relevant experience. It would be desirable to include such components in the project, firstly to bring together all key stakeholders, and secondly, to ensure that the large body of international experience can be brought to bear most fruitfully to build local capacity for analysis on this issue and to ensure that the project uses the most productive and up-to-date methods of analysis.
- One of the approaches to valuing environmental costs of electricity supply entails estimating *damage costs*. While a fair amount of work has been done in monitoring environmental impacts in the Eastern Transvaal

Highveld, it would be desirable to have an independent assessment made of these physical impacts, especially with a focus on establishing the *dose-response relationship* between pollution and environmental damage. Likewise it would be useful to have predictions of *future* damages based on current trends, for example, in the form of reduced productivity of forest crops in the area where acid precipitation is highest. If this kind of assessment were to be performed, it should be contracted to suitable environmental scientists, preferably including one or more persons with relevant experience from industrialised countries.

- In a larger, better-resourced project, it would be desirable to include an *affirmative action training component*. This should be consistent with EDRC's human resource policies and could follow two options. Firstly, if the scope of research expands sufficiently to require two researchers, EDRC would seek to employ a black or woman South African as a member of the research team. Alternatively, support could be gained to cover the costs of placing a trainee in one of EDRC's training courses, with the trainee being nominally attached to this project during the course. On completion of training courses, it is EDRC's practice to assist trainees in moving to permanent positions in the energy sector, either within EDRC or other institutions.
- In developing this proposal, resource constraints prevented consideration of *energy efficiency issues* related to the *demand-side*. Whilst the current project's focus, which is on the supply-side of the electricity sector, is valid and important in its own right, it would be preferable, from an Integrated Energy Planning perspective, to also consider the potential for energy efficiency and conservation gains achievable in industrial energy use and to propose policy directions for their achievement. International trends suggest increasingly that such savings may be very significant and, moreover, achievable at low or even negative cost. Improved energy efficiency should therefore be an important component of any policy measures which might cause energy price increases from the supply side. The subject of energy efficiency and demand-side management (DSM) is enormous and still growing rapidly; it is hoped that the current project may therefore form part of a suite of projects consistent with an Integrated Energy Planning approach which, by definition, also includes the demand side.
- The growth paths followed by many developed countries have been characterised by structural conditions very different from those facing a resource- and energy-intensive economy like that of South Africa. In particular, many developed countries have much higher energy prices, lower energy-intensities and less important resource-based sectors. These relationships are important in defining the nature of a country's development path and it may therefore be important to investigate whether *energy prices*, specifically, can or should play a role in *industrial policy* as a tool of policy-makers to direct the growth path along lines which are more productive in the long-term. Such a research project would necessarily focus on the historical experiences of developed and other developing countries in order to draw lessons for South Africa's own energy sector and industrial policy. Although this question is, by nature, addressed at *long-term* structural changes in the energy-economy, it merits attention in the short-term because of the lengthy periods required to effect to any large-scale structural shifts in the economy which might be implied by such an investigation.

Of the five issues described above, the first two relate to add-on components to the current project, which might strengthen its analysis, while the remaining three components widen the scope of work considerably, both in terms of research content and context. Efforts will be made to secure support from stakeholders and partners which may enable the scope of the current project to be expanded along the lines described in this section.

8 Brief curriculum vitae of relevant EDRC staff

Clive van Horen BCom CA(SA) BSocSci (Hons)
Clive qualified as a Chartered Accountant in 1991 and completed postgraduate studies in development economics in the same year. He has worked at the Energy for Development Research Centre since 1992 and is now the Programme Leader for the Centre's Energy Efficiency and Environment research. Over the past two years he has worked on a large research project, called the *Energy Policy Research and Training Project (EPRET)*, which produced a comprehensive household energy policy for South Africa, with the aim of widening access to energy services for the urban and rural poor. He produced two of the research papers, those dealing with environmental issues and with financing/economic aspects of the policies. He has also been closely involved in the work of the National Electrification Forum and has completed several projects related to the environmental and economic aspects of the energy sector in Southern Africa. He has published a number of papers, reports and articles during this period, is currently co-authoring (with Anton Eberhard) a book based on the EPRET project and is also completing a Masters degree in economics. Clive will be the researcher on the project.

Anton Eberhard BSc PhD (Edinburgh) BA (SA)
Anton has headed the Energy for Development Research Centre since its inception in 1989 and has initiated and led numerous projects related to problems of energy supply and demand in underdeveloped areas of South Africa. He was centrally involved in the design of the *Energy Policy Research and Training Project (EPRET)* and carried overall responsibility for the project. He is currently co-authoring the book based on the EPRET project with Clive van Horen, and has published a wealth of material on energy and development issues over the past decade. In addition to numerous positions and responsibilities in other energy and development organisations, he has overall responsibility for EDRC's management. Anton will have a supervisory role in the project.